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TWIN-STAGE, ON-LINE PI COMPARATOR SPECIFICATIONS
#02228

1. INTRODUCTION

These technical specifications described the requirements to be met in the fabrication of an operational prototype Twin-Stage Comparator.

2. CONCEPT

This project is to construct an instrument to provide the photo interpreter with a capability for obtaining precise measurements as part of routine photo interpretation.

The Twin-Stage Comparator is intended to bridge the gap between the high-precision mensuration tools currently available to the photogrammetrist and the cruder instruments normally used by the photo interpreter. In fabricating this instrument, emphasis is to be placed on ease of operation reliability, simplicity, measuring accuracy, and manufacturing production quantities of 10 or more at a reasonable price.

3. GENERAL DESCRIPTION

The two photo stages shall be supported on separate X-Y carriages and have a free aperture of 6 by 6 inches. A differential drive shall be provided between the two photo stages to permit stereo scanning of film chips of two different scales.

The movements of the X-Y carriages of both photo stages shall be measured by two digitizers (X-Y) with a measuring range of 6 inches in both the X and Y directions. The signals from the X-Y digitizers shall be processed and converted into a format acceptable for on-line computer use.

4. DETAILED REQUIREMENTS

4.1. Viewing System

The viewing system shall be a [redacted] High Power Stereo Comparator Head modified to permit increased separation of the two turret optical center lines to approximately 18 inches. STAT

4.1.1. Independent fine focus adjustment shall be provided for each leg of the optical system.

4.1.2. The contractor shall provide the following objectives with the instrument; two (2) each: [redacted] Fluotar (5100)-3.0X; [redacted] Fluotar (5105)-6.0X; [redacted] Fluotar (5050)-10.0X. Provision must be made to accommodate the [redacted] Special Order 1.3X objectives which will be furnished GFE.

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4.1.3. The contractor shall provide the following eyepieces with the instrument; two (2) each: [redacted] Compensating (5551)-6X; [redacted] Compensating (5583)-10X.

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4.1.4. A sharp round black reticle 20 microns in diameter shall be provided in both the left and right leg of the optical system.

4.1.5. The image quality of the modified [redacted] High Power Stereoviewer Comparator Head will be no less than 85% of those values for an unmodified High Power Stereoviewer. These quality standards apply to all of the optical parameters. This means that the modified comparator shall have an optical quality of no less than 85% of the unmodified stereoviewer. This degradation includes any produced by the glass pressure plate. The size of the field of view will equal that of the unmodified instrument. The image will remain in focus throughout the zoom range.

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4.1.6. The illumination level through the complete optical system shall be no less than 85% of the illumination through a unmodified High Power Stereoviewer Viewer at the same magnification.

4.1.7. The illumination at the eyepiece through a neutral density of 2.0 shall be at least 20 ft. lamberts. The design goal shall be 25 ft. lamberts through a neutral density of 3.0.

4.2. Film Stage and Holddown System

4.2.1. There shall be two film stages, each capable of handling film chips in sizes up to 6 inches by 6 inches.

4.2.2. Each of the film stages shall be supported on separate X-Y carriage assemblies.

4.2.3. Each of the film stages shall have independent translation of ± 3 inches in both the X and Y axis. Appropriate warning signals and cutoff circuitry shall be provided to prevent damage to the film stages when they are on a collision course. The optical viewing systems and the illumination source shall remain stationary (in X and Y).

4.2.4. Each stage shall provide 360° rotation capability of its film support surface about the center of the clear aperture.

4.2.5. The range for both independent and common stage drive speeds shall be from no faster than 5 microns per second to no slower than 5 millimeters per second. A design goal shall be a maximum speed of 10 Millimeters per second. Film hold-down may be accomplished through glass pressure plates or other mechanical means, but it must be capable of maintaining the film flat and in sharp focus over the format. If a glass pressure plate is used, its thickness shall not exceed .063 inches.

4.2.6. The film platen and holddown system shall be such that will maintain the film in sharp focus over the entire format using the 1.3X and 3X objective lenses. At high magnifications (up to 200X) the film shall be flat and in sharp focus over a minimum of 1 inch square. This means that when the optical system is focused at any point within the 6" X 6" viewing area, no refocusing will be required when viewing within a one inch square surrounding this point.

4.3. Film Measurement System

4.3.1. Both film stages have a measuring capability. Each of these measuring stages shall have two-axis (X and Y) digitizers with a measuring range of ± 3 inches in both axes. The movement of the X-Y carriages of the two photo stages shall be measured by four digitizers (Left X and Y, Right X and Y) with a measuring range of 6 inches in both the X and Y directions. The signals from the X-Y digitizers shall be processed and converted into a format acceptable for on-line computer use.

4.3.2. The prime objective of this system is to produce the highest possible accuracy over short distances (up to 1 inch) with less emphasis on accuracy over longer distances. The accuracy shall be 2-micron accuracy for measurements of 1 inch or under. An accuracy of at least 2 microns plus 1 part in 100,000 shall be provided over the entire film format.

4.3.3. The least count or pulse increment shall be 1 micron.

4.3.4. The deviation from orthogonality of the X and Y axis of the measurement system shall be less than 5 seconds of arc.

4.4. Measurement Readout System

The Twin Stage Comparator is intended for on-line computer use at the customer's facility utilizing a UNIVAC 494 as the central computer.

4.4.1. The contractor is authorized to substitute a measurement readout system (or digital acquision system of his choosing) for the [redacted] equipment recommended in the Development Objectives as long as it is compatible with the in-house on-line computer system.

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4.4.2. The Contractor will provide and fabricate: (1) a control panel [redacted] 2825A or equivalent) with integral visual display; (2) movable cabinet (on casters) containing the necessary electronic decoders, synchronizers, buffers, special character generators, etc. to process and convert the data from the two two-axis encoders and from the control panel into a signal which will be accepted by the central computer utilizing existing programs.

4.5. Stage Illumination

4.5.1. General. A high-intensity optimized condenser type light source shall be provided beneath the surface glass plate of each chip stage. This source shall be designed for and mated with the microscope to insure maximum total performance from the optical viewing system.

4.5.2. Intensity Range. At full intensity, the high-intensity sources must provide an eyepiece brightness of 20 ft. lamberts through a neutral density of 2.0 units as viewed through the optical system at both eye stations while operating at a magnification of 200X. All other magnification settings shall be equally well illuminated. These sources shall operate at a color temperature between 2800°-5500°K (the apparent color temperature shall be that of white light).

4.5.3. Variability of Intensity. Means shall be provided for continuously varying the illumination from 50% to 100% of full intensity on each independent high-intensity source without reducing the color temperature below 2800°K. The apparent color temperature will be that of white light. In addition, Schott glass neutral density filters shall be used to accommodate for the wide variety of illumination conditions required by the film density variations from 0.0 to 3.0.

4.5.4. Control of Intensity. Separate controls for varying the intensity of illumination of each separate illumination source shall be provided.

4.5.5. Heat. The temperature on the surface of each stage plate shall not exceed 100°F after operating at maximum intensity over a 8-hour period in an 80°F ambient temperature while a neutral density of 1.5 covers the plate. Necessary care shall be taken to assure that the film is adequately cooled so as to prevent dimensional changes which could affect mensuration reliability.

4.5.6. Overall Illumination. A second, overall lighting system shall be provided to illuminate the entire format for general viewing and pre-selection of points to be measured. The flicker frequency should exceed 80 cycles per second.

4.6. Control Console

4.6.1. General. The complete system shall be designed in accordance with correct ergonomic principles for easy, comfortable, rapid operation.

4.6.2. Controls shall be provided for setting a 5 to 1 (or larger) variable differential drive to couple the corresponding axes of the second stage.

4.6.3. Controls shall permit independent translation of either stage or common translation of both stages with a single "joystick."

4.6.4. The stage drive controls for both slewing and fine positioning shall be smooth and positive.

4.6.5. Continuously variable speed drive controls to cover the range of 5 microns per second to 5 millimeters per second.

4.7. Overall Physical Considerations

4.7.1. The size of this comparator is to be kept at a very minimum. The length and width shall be no greater than 48 inches by 34 inches.

4.7.2. The comparator shall have its own stand or mounting and shall be provided with suitable casters for moving. Leveling pads or mounts, that can be easily and quickly activated, shall be provided.

4.7.3. This instrument shall be designed to operate in a normal PI work area. The environmental conditions in this work area will normally be held to temperatures of 72°F ±5° and relative humidities of 55% (+15% to -5%).

4.7.4. Shielding shall be provided throughout the system so that no circuits are adversely affected by RFI.

4.7.5. The knee well shall be no less than 25 inches high and 24 inches wide and 22 inches deep. The eyepoint shall be approximately 41 inches from the floor when the eyepieces are in the 25° position. The viewing stage shall be approximately 32 inches from the floor. The eyepoint shall be as close to the front edge of the instrument as possible.

4.8. Reliability and Service Time

4.8.1. The comparator and related equipment shall be designed to withstand service usage, under normal operating conditions, for a period of 2000 hours (5 hours per day operation) without significant degradation of performance, and with only minor maintenance due to normal expendable replacement parts. Mean time between failures shall be no less than 200 operational hours.

4.8.2. Reliability and maintainability shall be a major factor in the fabrication of this instrument.

4.8.3. The design shall permit: (1) ease of assembly and disassembly, (2) ready access to potential trouble sources, (3) maintenance with tools and equipment normally available to maintenance personnel, and (4) external test points.

4.8.4. High Voltage areas shall be properly interlocked for maintenance purposes. These areas shall be properly labeled. Circuits operating with an open circuit potential of 30 volts or more and a capability for delivering 2.5 peak milliamperes or more into a short circuit shall be considered hazardous and shall be labeled and interlocked.

5. MISCELLANEOUS

5.1. At the time of delivery of the equipment, the contractor shall also provide the following: (1) Operators Instruction Manual; (2) Maintenance Manual (including schematics); (3) Recommended spare parts list, including the cost of each item and the total parts package cost.

5.2. Electric Hazard

The unit must be grounded and free of all electric shock hazards. All electrical circuits shall be properly fused and spare fuses shall be supplied with the instrument.

5.3. Warning Light

A warning light must be provided to show when the power supply to the system is switched on.

5.4. Controls

All switches and controls must be properly and clearly marked, conveniently located, and readily accessible to the operator.

5.5. Alarms

Limit switches shall be located at the extremes of travel of the X and Y carriages of both film stages to prevent damage to the system.

5.6. Interface

The contractor shall be responsible for all electronic interfacing, logic circuitry, and cabling between the digitizers, encoders, digital display, and on-line computer.

5.7. Noise

The maximum equipment noise energy levels shall not exceed Noise Criteria Curve 40 per MIL. STD 803 A-2. Measurements shall be referenced to the normal head position of the average operator.

5.8. General

The instrument shall be free of all sharp corners. No exposed surface of the instrument shall exceed 110°F unless protection is provided to avoid bare skin contact.

Guards shall be provided on all moving parts on which personnel may become injured or entangled. Nominal openings in any guard most not exceed 1/2 inch. Guards shall visit deformation while in normal use. Unless specifically enumerated in this specification, the instrument shall comply with Section 4.0. of the Human Engineering Design Guide for Image Interpretation Equipment prepared by the STAT [redacted]